FIRE CONTROL FOR THE LONG-RANGE RIFLEMAN

NDIA
Las Vegas
May 12, 2004

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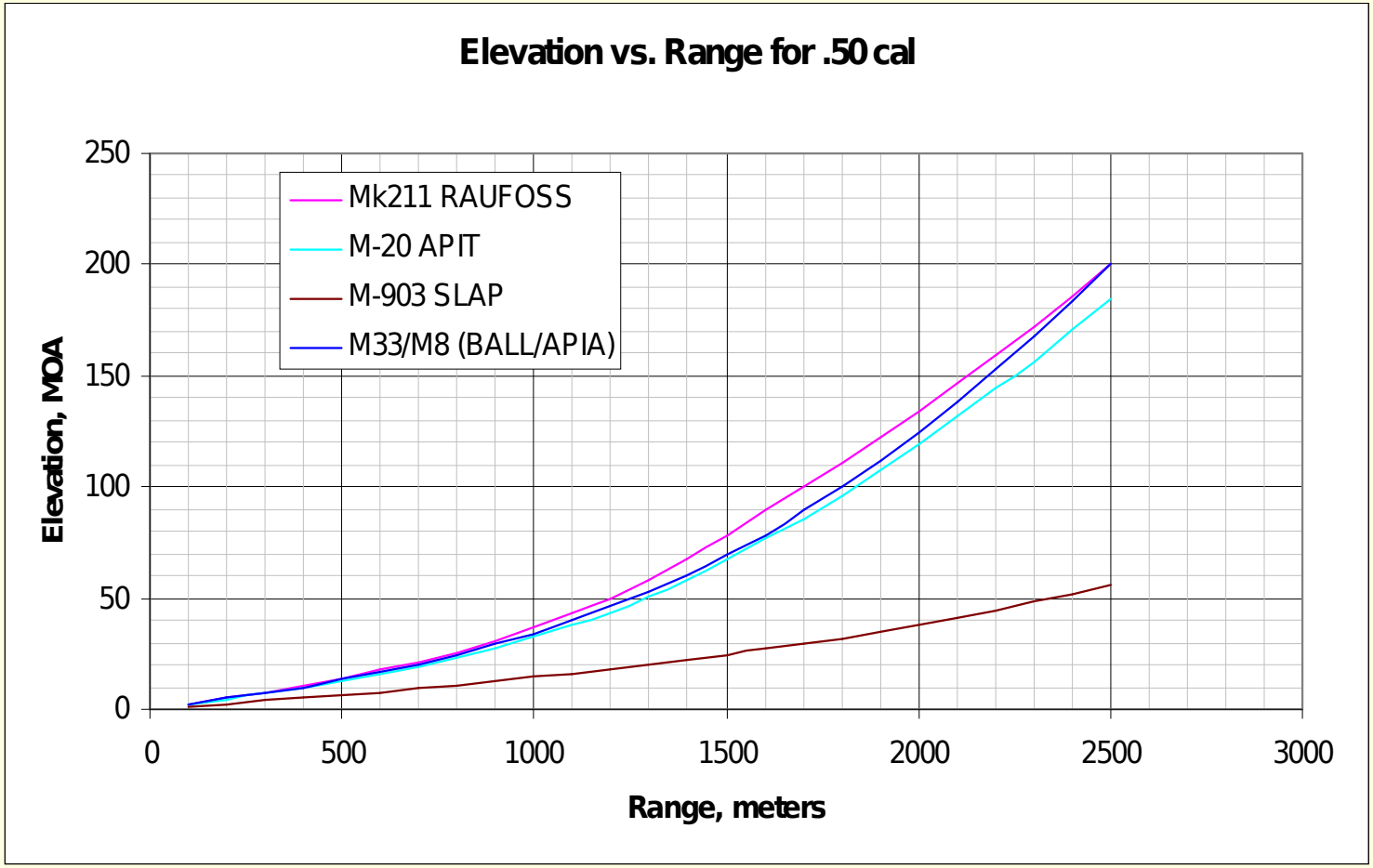
The Problem:

- The accurate range of current and future rifles approach distances previously reached only by crew-served weapons
  - Hathcock and M2/Unertl combo in Vietnam
  - Gulf War, Afghanistan, Iraq (BMP’s at 2,000 m)

Problem Details

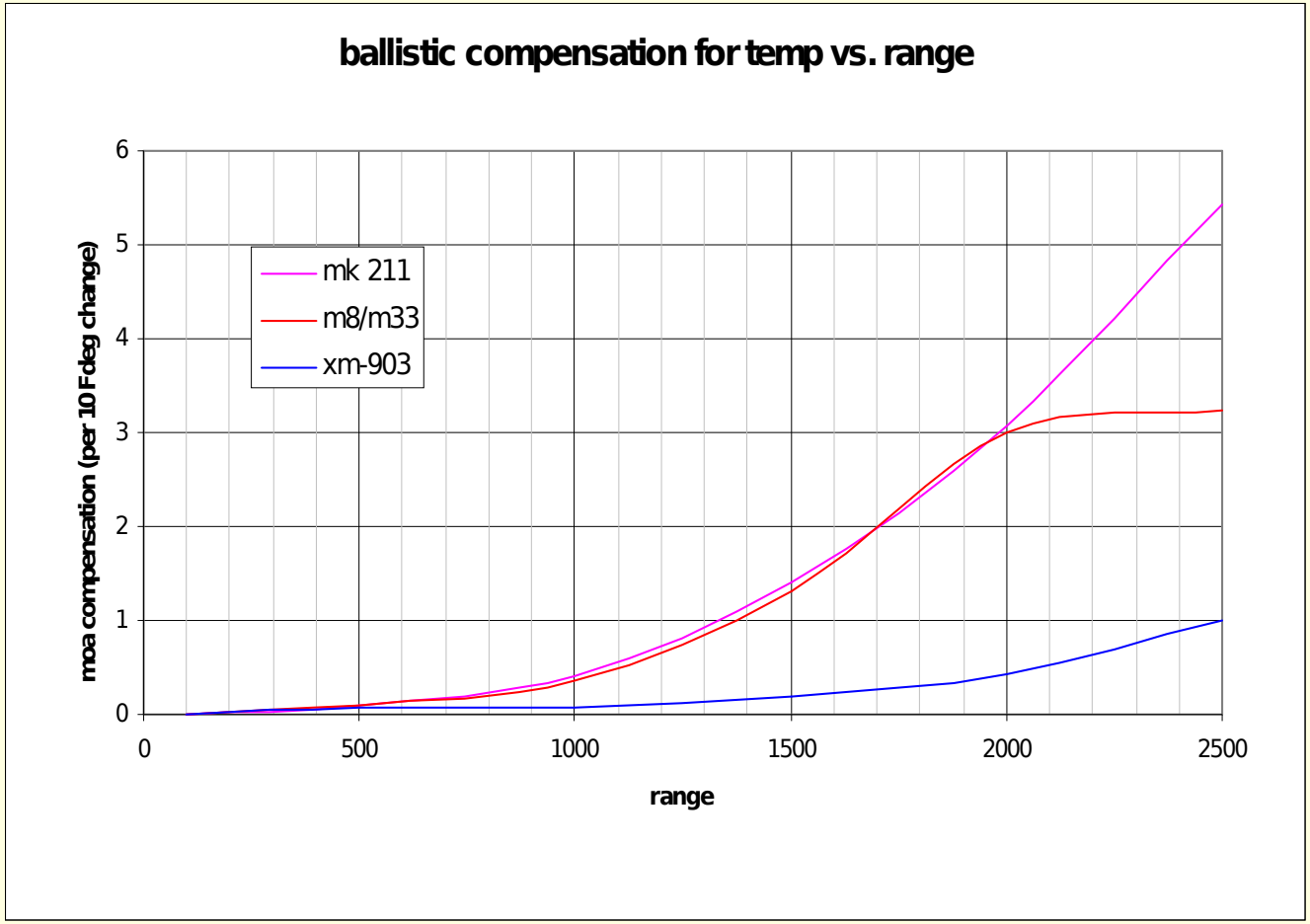
- Currently sight systems for these weapons are inadequate
  - Ammunition usable range > 2,000 m
  - Air temperature compensation through gunner computation
  - Barometric compensation by gunner computation
  - Weapon tilt (uphill/downhill shooting) by gunner computation
  - Elevation requirements approximately 200 MOA to utilize effective range of current ammunition
    - Variable magnification riflescopes << 200 MOA elevation
    - A few fixed magnification riflescopes = 200 MOA elevation
    - No riflescopes > 200 MOA elevation

.50 cal Elevation vs. Range*



* SOURCE: GENERAL INSTRUCTIONS FOR USE OF .50 CAL FIRING TABLES

Temperature Compensation with Range



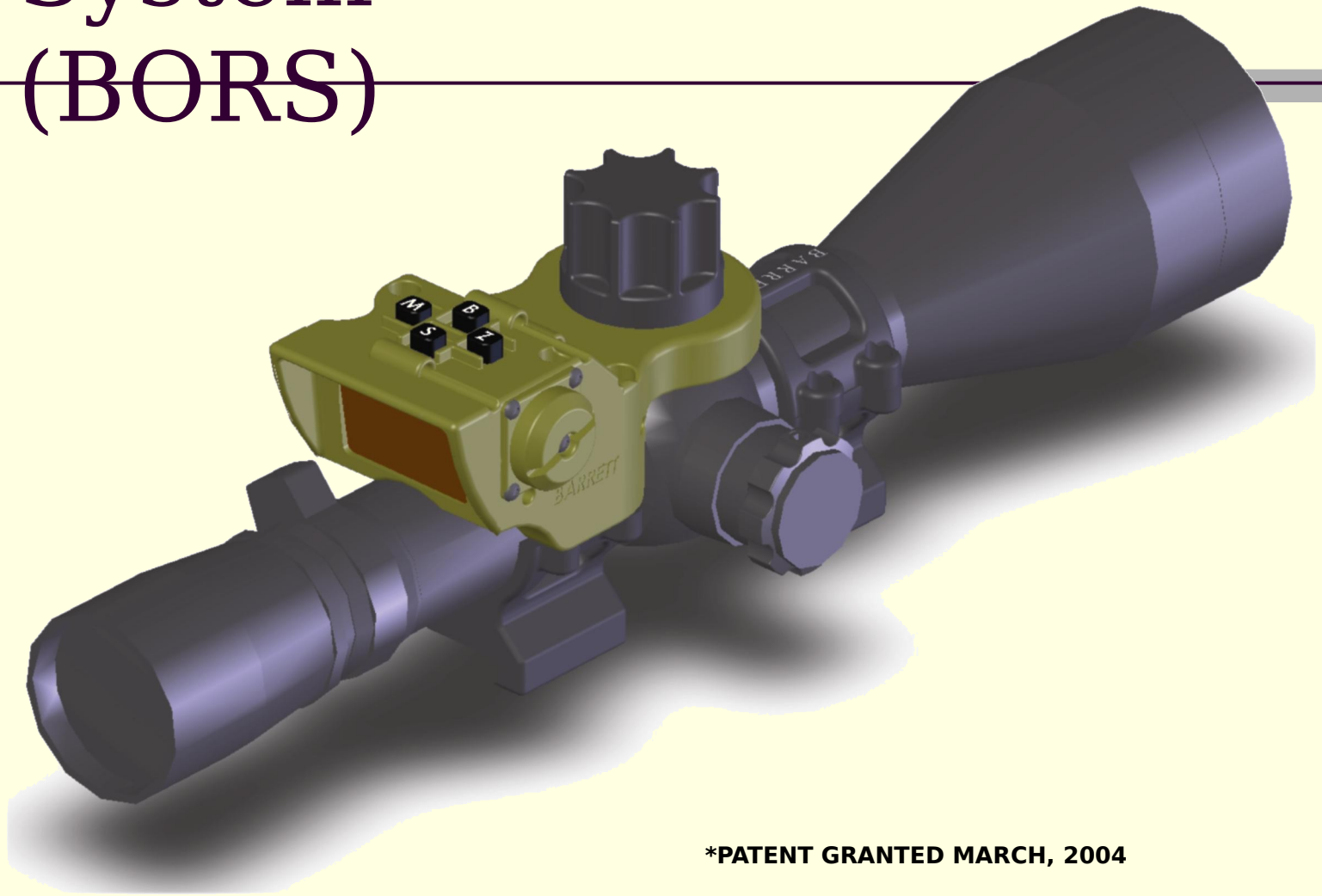
More Problem Details

- Currently sight systems for these weapons are inadequate(continued).
  - Elevation typically dialed in by “counting clicks”
    - ¼ MOA / click (typical riflescope) * 100 MOA = 400 “clicks”

Setting Up the Long-Range Shot

- Therefore, setting the elevation for an accurate long-range shot can be a very complicated process for the rifleman:
  - Determine/estimate the range
  - Determine the MOA for the round chambered in the weapon
  - “Count clicks to set that MOA
  - Estimate the temperature difference between ballistic table zero and current conditions
  - Determine temperature compensation factor
  - Multiply or divide elevation setting by temperature compensation factor
  - Do the same for barometric pressure
  - Do the same for pitch

Barrett Optical Ranging System* (BORS)



*PATENT GRANTED MARCH, 2004

How BORS Helps the Rifleman

- BORS does all that *for* the rifleman so he can concentrate on aiming the weapon
- BORS:
  - Monitors the setting of the riflescope's elevation knob
  - Senses the air temperature
  - Senses the barometric pressure
  - Senses rifle tilt
  - Computes temperature compensation
  - Computes pressure compensation
  - Computes tilt compensation
  - Applies these compensations to ballistic data & elevation setting
  - Displays the range at which the weapon is set

Using BORS

- To use BORS, the rifleman:
  - Determines the target range
  - Selects what round he has chambered into the rifle
  - Turns the riflescope elevation knob until the displayed range matches the target range
  - Aims & Fires

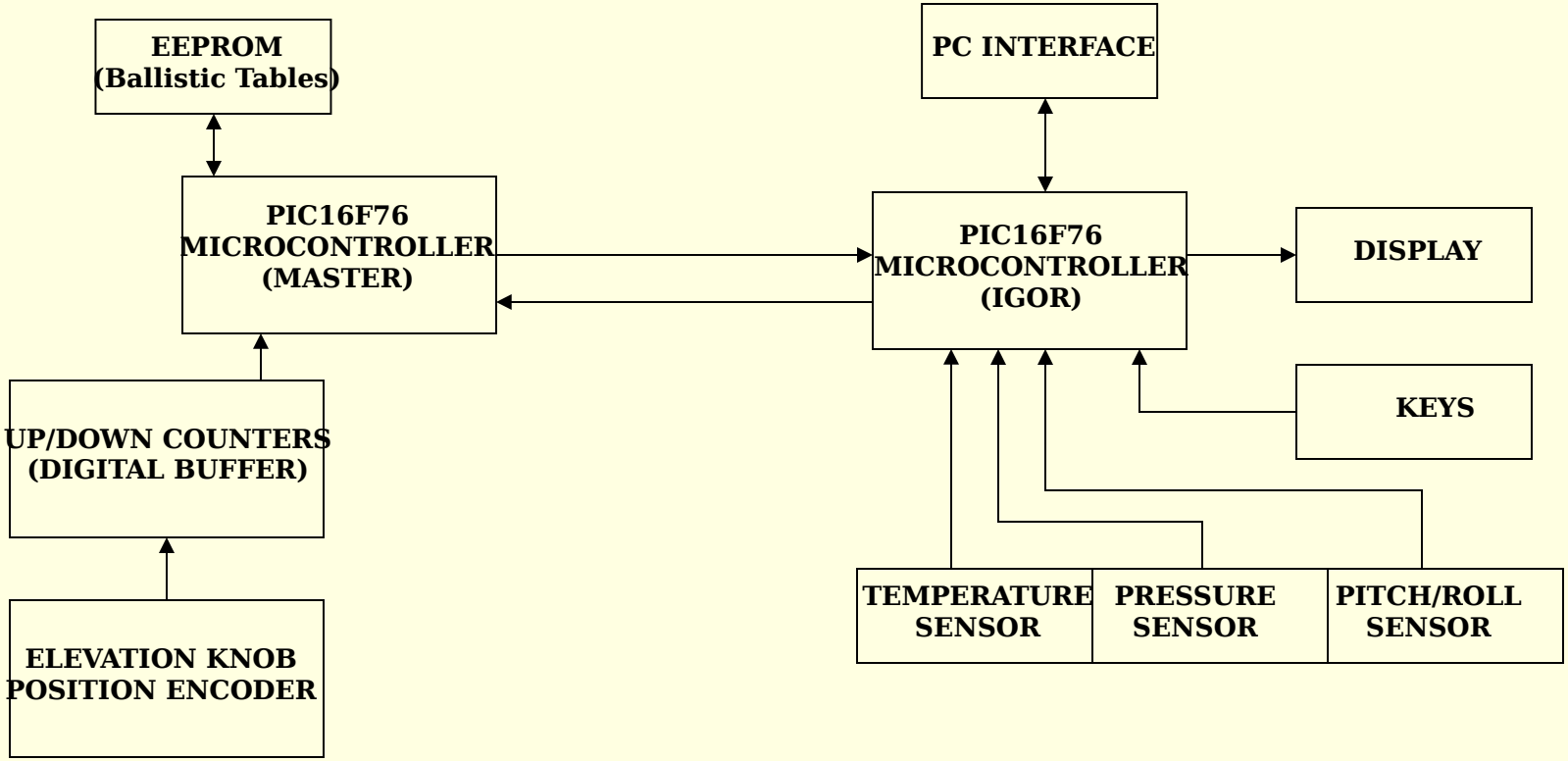
How BORS Works

- BORS adds an encoder to the elevation knob
- Elevation encoder is attached to a binary up/down counter (10 bits) that “counts the clicks”
- A Microcontroller continuously monitors that counter.
- The same microcontroller accesses an EEPROM in which ballistic tables for all weapon rounds are stored
- Algorithms in this controller determine range from the elevation knob setting, and applies all the compensation factors
- This is the ballistic, or “master” controller for BORS
- It is *always* on
- It does have a “sleep” mode for long term power saving

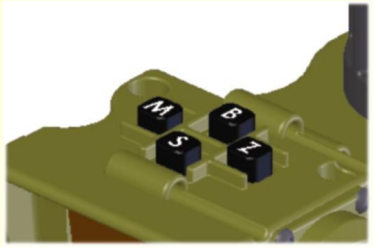
How BORS Works (cont…)

- **A second microcontroller monitors air temperature, barometric pressure, and tilt sensors contained in BORS**
- **This is the “housekeeping” controller (Igor)**
- **This microcontroller also monitors the input keys; controls the liquid crystal display, and provides a serial interface (RS-232) to a PC.**
- **The housekeeping and encoder microcontrollers exchange data whenever changes occur**
- **The housekeeping uC and all it’s connected systems shut down after an idle period (to conserve the battery).**

Signal Processing



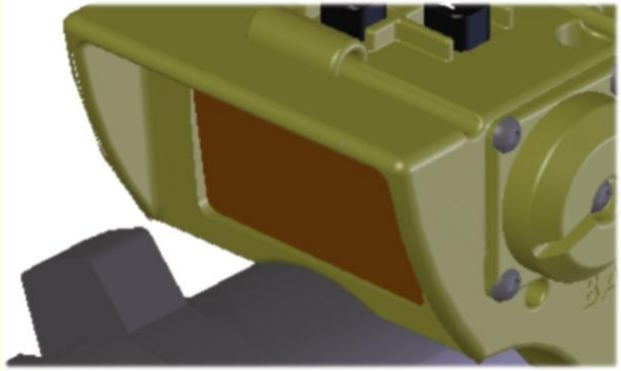
User Interface



- Four softkeys (Silicone Rubber) provide user input to BORS
  - S-key for round select
    - User scrolls through available round types
  - B-key for display brightness
    - User scrolls through backlight brightness on LCD (including off)
  - M-key for menu items
    - User can view current settings and environmental data
  - Z-key for zeroing (calibration) BORS
    - User may calibrate system to provide starting/zero range for applying ballistic table data

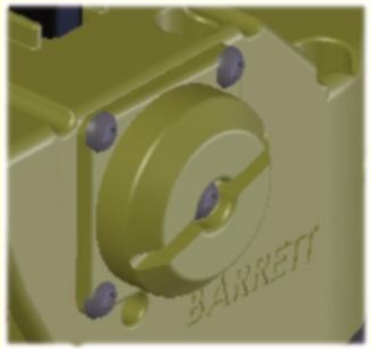
DISPLAY

- Transreflective Liquid Crystal Display (LCD)
- -20 to 85°C without heat(down to –40° C at full brightness)
- LCD backlight with PWM brightness modulation (256 levels)
- 2 lines, 8 alphanumeric characters per line



Power

- One CR-123 Battery (2/3 A)
- 3.6 V Lithium
- Common with cameras and Surefire® tactical lights
- Future option: rechargeable Li-ion



BORS Capabilities

- BLOCK I (current)
  - Elevation Encoder (existing scope)
  - Temperature, Altitude, Pitch Compensation
- BLOCK II (’05)
  - BLOCK I + Rangefinder
- BLOCK III (’06)
  - New Optics + NV+Image Stabilization+Wide Angle